NASA NGL 10-007-010

Project Summary

Multidisciplinary Research in Space Sciences

and

Statement of Allocations for Final Year of Step Funding

UNIVERSITY OF MIAMI
CORAL GABLES, FLORIDA

Eugene H. Man
Dean of Research Coordination
Principal Investigator

Eugene E. Cohen
Vice President for Financial
Affairs and Treasurer

September, 1971

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SURVIVAL OF MAN

(Concluding year of a total institutional approach to a Sustaining Multidisciplinary Program)

INTRODUCTION AND ORGANIZATION

In selecting projects for the concluding year of the NASA Sustaining University Program at this institution, the Research Council directed the Principal Investigator to select those areas of research which represented optimum growth potential for this institution within the context of the program theme "Survival of Man." The Council believes that the thrust toward programs dealing with various aspects of man's survival coincides appropriately with this institution's growing interest in environmental programs, including those of human ecology (behavior). The impetus provided by funds obtained in previous years from this NASA grant has been a major factor in influencing the interest in and growth of environmental programs here.

Three areas have been selected for funding this final year. Each is related to the Survival theme; one is a continuation of a program initiated last year, one is a continuation of a project supported earlier but with a somewhat different thrust, and one is a new area related to existing University strengths. Each represents a potential major effort with importance to the future of this University. Thus, their selection represents a potential impact on the University of Miami which will continue long after these funds are expended.

The three areas are:

1. Neurosciences
2. Biophysics of Cell Membrane Function
3. Organic Chemistry of Ocean Sediments

The programs, which include a project under the direction of the Sustaining University Program Principal Investigator, were approved by the Research Council. The Space Research Committee has been inactivated for the present, with its parent body, the University Research Council, taking over its functions.

SUMMARY OF PROJECTS (November 1, 1971--October 31, 1972)

1. Interdisciplinary Effort in the Neurosciences

This project was initiated last year to encourage a promising development of an interaction among scientists of a diversity of interests in the phenomena of nervous system mechanisms. The basic understanding of how the human brain and nervous system work is fundamental to an understanding of why man behaves as he does; consequently, the continuation of this effort has been selected for support under the Survival of Man program.

The continuation program will bring together persons representing psychology, biology, neurology, pharmacology, and biophysics in a program which may become the basis for a major interdisciplinary effort at the University devoted to the neurosciences and behavior.

2. Effect of Temperature on Living Cell Membrane

Earlier work of Dr. Walter Drost-Hansen supported by the Sustaining University Program dealt extensively with temperature effects on membrane and interface phenomena. As an outgrowth of this effort, a whole realm of environmental phenomena have been exposed which are basically affected by membrane transport mechanisms, and the effect of temperature on these mechanisms. One example is the current awareness of the impact of heated effluent from power plants on marine species.

The current project is being undertaken by a marine biophysicist working with colleagues in the Department of Microbiology at the School of Medicine. This work has importance to understanding both marine and land organisms, with ultimate benefits to both medicine and biology.

3. Organic Chemistry in Ocean Sediments

The earth is an aqueous planet, and Man's survival here may ultimately depend on his understanding and capability to use and preserve the oceans. Much of the chemical activity of the ocean is focused in marine sediments, which contain organic residues derived primarily from marine organisms and run-off from land and rivers. The chemical fate of these materials relates directly to ocean productivity of mineral and organic resources, to life processes in the oceans, and to the survival of the oceans under the impact of a continuous input of the products of nature and civilization.

The project selected is new to this Sustaining University Program, but ties together work in biology, chemistry, geology, and oceanography. It also is providing an opportunity for inter-institutional cooperation, since most of the project will be carried out in the Scripps Institution of Oceanography as a cooperative program.

Interdisciplinary Effort in the Neurosciences - A Combined Physiological, Biochemical, and Behavioral Approach to Synaptic Mechanisms

Investigators: Dr. Robert Davidoff
Associate Professor of Neurology and Pharmacology

Dr. William Evoy
Associate Professor of Biology

Dr. Seymour Joffe
Associate Professor of Neurology, Biology, and Biochemistry

Dr. Neil Schneiderman
Associate Professor of Psychology

Associates: Dr. Pedro Diaz, V. A. Hospital
Dr. Harvey Swadlow, Visiting Investigator
Miss Christina Loveridge, Graduate Student, Biology
Miss Lynn Eastman, Graduate Student, Physiology and Biophysics
Mr. James Francis, Graduate Student, Psychology

Introduction

To attempt to understand working relationships within nervous systems, it is necessary to determine the mechanisms of information transfer at the synapse, the region where nerve and muscle cells communicate with one another. The proposed approach to this problem deals specifically with the chemical mechanisms by which information is transferred from one cell to another and the membrane mechanisms which have evolved to recognize particular chemical transmitter species and yield subsequent electrical and behavioral responses.

Objectives

To date, investigations of synaptic mechanisms have concentrated primarily on systems in which acetylcholine is the synaptic transmitter. In the present investigation, we will deal with gamma-aminobutyric acid (GABA), a candidate for an inhibitory transmitter in both mammalian central nervous systems and certain invertebrate neuro-muscular junctions and with the role of nor-epinephrine as a transmitter in the mammalian central nervous system.

The approach is to combine available skills - biochemical, biophysical, histochemical, neurophysiological and behavioral - in order to investigate the chemical specificity of synaptic transmission. This work will involve several preparations - isolated membrane proteins from mammalian brain and crustacean muscle, intact crayfish muscle, and intact live rabbits. The several laboratories involved are well equipped for work in these areas. Dr. Joffe's laboratory provides facilities for work with membrane proteins and proteolipids; Dr. Davidoff's and Dr. Evoy's laboratories, electrophysiology at the cellular level; Dr. Diaz's laboratory, neuorchemistry; and Dr. Schneiderman's laboratory, brain stimulation, single unit and overt response recording.

The group interacts closely through collaborative experiments in the several laboratories and through discussion meetings of background information and current progress. The problem chosen promises to provide aspects of interest throughout the neurosciences, both theoretical and experimental. We hope that by combining a number of research talents, we will have laid foundations for future broadly-based interdisciplinary study in neuroscience.

Progress To Date

(Investigator: Seymour Joffe, M. D., Ph. D.
Research Scientist: Magar E. Magar, Ph. D.)

The efforts supported by this grant were in part directed towards promoting interchange among the neuroscientists on the campus. Toward this end, Dr. Magar helped in the organization and editing of a symposium held by the Center for Theoretical Studies on the "Physical Principles of Neuronal and Organismic Behavior." Dr. Giuseppe Calacicco from the Albert Einstein College of Medicine was brought down under the auspices of this grant and spoke to graduate students and faculty on the behavior of membrane proteins and lipids as studied by surface films.

In terms of research efforts, progress has been made in studying the macromolecular organization of the myelin membrane. Nuclear magnetic resonance studies have been initiated on a succinylated protein-lipid complex derived from calf brain myelin and myelin itself. The complex is of some interest since it represents a possible protomeric unit in the assembly of this membrance. In the NMR studies, peaks can be identified as choline and sugar as they can in whole myelin. However, the peaks in the complex are

broadened, indicating restricted freedom of motion and the spectra do not change in TFA which should theoretically act to unfold proteins at least on the surface of the complex. These observations strongly suggest that there is a tightly bound population of lipids (sphingolipids) in myelin probably sequestered in the interior of the protein complex in myelin separate and apart from the major portion of lipids forming the central core of the unit membrane. Further probing of this complex by NMR will be done using F1-19 to study conformation changes in the protein moieties of the complex.

The second direction of research has been in the isolation and characterization of the proteolipid apoprotein from myelin. This protein, though constituting the major protein constituent in myelin, still remains incompletely characterized. The final lipid-free material which is isolated is clearly shown to be an aggregate in electron micrographs taken of our preparation. What are seen are parallel-running chains 15-20 A^{o} wide. Specific characterization of these aggregates is being done in the ultracentrifuge. 8 M urea does not dissociate the aggregate. Investigation of the effect of SDS and mercaptoethanol is now in progress. On disc gel electrophoresis, two bands are detected while on Sephadex G-100 chromatography as many as four peaks are obtained. Whether we are dealing with separate polypeptides or differing states of aggregation remains to be determined.

Program

In order to determine the mechanisms of action of GABA and norepinephrine in normally functioning systems, we propose to isolate and characterize the membrane-related receptors and the pathways in which they normally function. Different systems lend themselves to particular aspects of this problem. Previous work with acetylcholine-mediated systems suggests that synaptic transmitters are bound by proteins or proteolipids. Whole mammalian cortex, homogenized and and separated by density gradient centrifugation into several fractions will be used in these studies. The several fractions consist of membranous components of both neural material and myelin. These will be assayed chemically for enzymatic activity as well as for the presence of transmitter substances. Binding of radioactively labelled transmitter candidates such as C 14 GABA as well as specific blocking agents (H 3 Bicuculline) to the separated fractions will be determined by established procedures to mark the receptor sites on the membrane. In this way, we hope to characterize the nature of the molecular components which specifically combine with the transmitter during the process of synaptic transmission.

In order to better characterize the natural action of synaptic transmitter substances at membrane receptor sites on intact membrane, electrophysiological measurements of membrane potential and conductance changes

are made using the response of crayfish muscle to GABA applied locally from an iontophoretic pipet as well as that introduced in known concentrations to a bath. The effects of various known blocking agents which affect the action of GABA (Bicuculline, picrotoxin, B-guanidino-propionic acid, etc.) will be determined. An attempt will be made to isolate the membrane receptor from this muscle in a manner similar to that employed in mammalian cortex. In this manner, we hope to establish the nature of the membrane receptor as well as the way in which combination of the receptor with the transmitter yields the membrane response.

Another aspect of the study is to examine the release of presumptive synaptic transmitter from nerve terminals and to determine the sites of their action in bringing about overt behavioral responses in the intact nervous system. These experiments will be carried out in the hypothalamus and other related structures following intracranial electrical or chemical stimulation of the septal region or hypothalamus in unanesthetized rabbits. The experiments will deal primarily with the events related to synaptic transmission mediated by norepinephrine and related aminergic compounds. In the first set of experiments, the hypothalamus of unanesthetized rabbits will be perfused with Locke's solution through a chronically implanted push-pull cannula after intraventricular injection of a radioactive aminergic tracer. Following assay of tracer, cardiovascular responses and release of monoamines will be compared as a function of intracranial electrical and chemical stimulation. A second set of experiments will utilize techniques similar to those employed in the experiments on crayfish muscle, in order to locate as specifically as possible the regions of action which yield behavioral (autonomic) responses and the types of interaction between membrane reacting pharmacological agents. Here, extracellular recording of activity from single neuronal units and iontophoretic application of autonomic agonists and antagonists will be combined with intracranial chemical or electrical stimulation.

Publications

Joffe, Seymour. "Isolation and Some Properties of a Succinylated Protein-lipid Complex Derived from Calf Brain Myelin," Arch. Biochem. Biophys. (In Press).

Drs. Davidoff, Evoy, Joffe, and Schneiderman

"Interdisciplinary Effort in the Neurosciences - A Combined Physiological, Biochemical, and Behavioral Approach to Synaptic Mechanisms"

BUDGET

November 1, 1971 - October 31, 1972

SALARIES		
Dr. Harvey Swadlow Visiting Investigator Part Time - 4 months @ $400 per month	$1,600.	
Total Salaries		$ 1,600.
SUPPLIES AND SERVICES		
Chemicals (including drugs and isotopes)		2,000.
Glassware		800.
Electrical Supplies		500.
Animals		850.
Fica		86.
CAPITAL EQUIPMENT		
2 Channel Brush Recorder	2,500.	
Digitiner Electrical Stimulating Apparatus	2,735.	5,235.
TOTAL DIRECT COSTS		$11,071.
INDIRECT COSTS (20% of Direct Costs)		2,214.
TOTAL FROM NASA		$13,285.

The Effect of Temperature and Temperature Gradients on the Living Cell Membrane

Investigator: Dr. Anitra Thorhaug

Consultant: Dr. Aharon Katchalsky

Introduction

There are two compelling reasons for undertaking an investigation of the phenomena of temperature and temperature gradient dependencies of transport in the living cell system. First, temperature gradients have been seen to be powerful driving forces for physical chemical systems and they have been virtually ignored in all systems. They are the only major driving force which has been almost completely neglected in cell membrane biophysics. This is difficult to explain since a gradient of as little as $0.01^{\circ}C$ across a membrane would result in an effect of $10,000^{\circ}C/cm^2$. Temperature dependencies provide basic thermodynamic information necessary to correlate the kinetic approach to membrane biophysics with various thermodynamic models. Specifically, this investigation should provide new information on heat and entropy of transport, which are related to the mechanism of permeation and to membrane structure. The entropy of permeation of water structure, for instance, would give an indication of whether the water entered through aqueous channels, was transferred by electrons or other proposed mechanisms. In addition, temperature information is essential to understanding membrane energetics.

The second reason is dictated by the conviction that there is a whole realm of important environmental problems which are biophysical in nature and must be solved by biophysicists. The application of the techniques and knowledge of biophysics to the marine sciences is similar to its successful application to problems of medical sciences. Moreover, this may be an advance of biophysics into a new set of problems which may, by their different physical characteristics from those of the land and aquatic organisms show limitations to some of the principles now established in biology. For example, the water and salt balance for marine organisms is entirely different than the fresh water or land organisms. It is fully realized that investigations into certain biophysical problems have used marine organisms. However, these were always specimens which offered certain experimental advantages, rather

than for the sake of solving problems interesting to the marine world. An example is the study of membrane by using squid axons; these were never extended into problems of the marine environment.

In reviewing the basic physical and chemical parameters acting on marine organisms the most important are temperature and pressure (Moore, 1958; Hedgepeth, 1957). A great deal of information exists on distribution of organisms with respect to temperature and of whole organism physiology responses to temperature. Also, the investigation of temperature on a molecular level for specific biochemical compounds has provided us with a good deal of thermodynamic information. However, in the intermediate levels of biological organization--between the population and whole organism and the biochemical compound--very little information is available for marine organisms. In particular, the effect of temperature on the highly important barrier for substances leaving and entering the cell, namely, the plasma membrane, has been largely overlooked (for a review see Thorhaug, 1969 and 1971). Koczy (1966) came to the obvious and thus startling conclusion that the controlling barrier between the vast biomass of marine organisms (the unicellular algae and bacteria) and their environment is the plasma membrane. Thus, it is immediately obvious that the effect of temperature and pressure on the biophysical properties of membrane is of fundamental importance in understanding the marine environment. Of these, temperature, more readily manipulated in the laboratory and of greater importance in the thermodynamic relationship

$$\bar{\mu} = \bar{\mu}^{*} + \bar{PV} + RT \ln a + \lambda + 2F\psi$$

has been chosen for study.

Objectives

It is proposed to investigate the effect of temperature and temperature gradients on the living membrane system of the single cell Valonia. This green marine alga has been used for some 70 years as a physiological tool for understanding marine algae, physiology in general and membrane properties specifically. Specifically, the active and passive flux of potassium, sodium, chloride and water under isothermal and non-isothermal conditions will be measured. In addition, an attempt will be made to interpret this data in terms of thermodynamic and non-equilibrium thermodynamics.

Program

The laboratory technique for accomplishing isothermal and temperature gradient perfusion on the giant single cell alga, Valonia, has been described in detail (Thorhaug, 1971). Basically, this method consists of establishing two compartments, one inside the cell and one external where the solutions are temperature controlled (See Figure, point A & J). The two temperatures can be controlled to $\pm 0.01^{\circ}C$ between 0 and $50^{\circ}C$, the physiologically interesting range.

The flow of tracers (THO, Na^{22}, K^{42}, Cl^{36}) into or out of the cell will be measured. Outflow can be followed by placing the tracer(s) in the inflow syringe (See Figure, point P) and collecting samples from the well-stirred external media. Influx can be measured by placing the tracer in the external media and collecting samples from the effluent pipette (See Figure, point H). Simultaneously with measurements of these processes, the potential difference and conductance across the membrane system will be measured (See Figure, points V, X, Y, Z).

Personnel

Dr. Anitra Thorhaug will act as Principal Investigator on this project. Dr. Aharon Katchalsky will act as consultant without charge. Dr. Marcela Fernandez will aid in laboratory procedures.

References

1. Hedgepeth, J. P., "Treatise on Marine Ecology and Paleontology," Geol. Soc. Am. Mem., 67: 159 (1957).

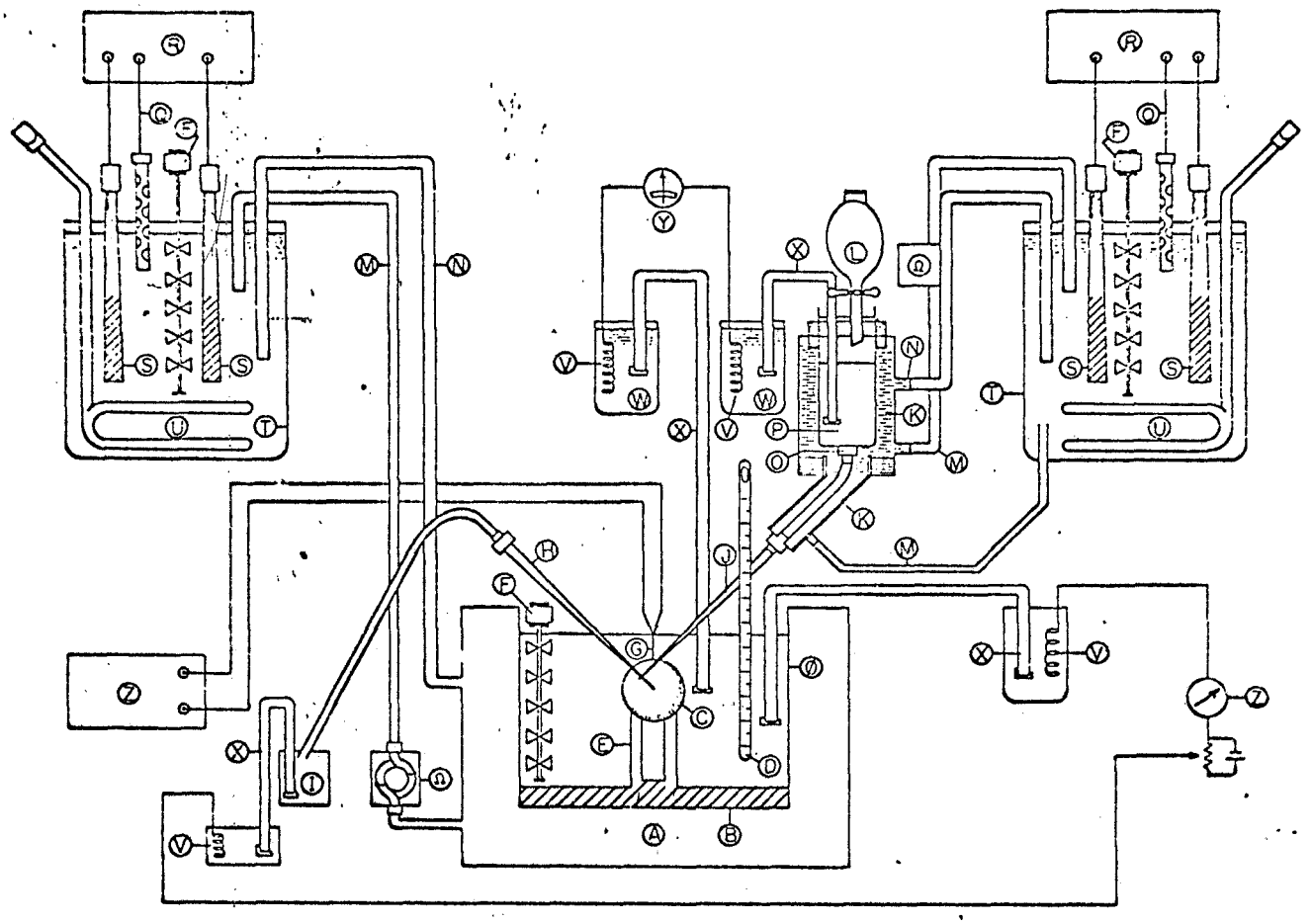
2. Koczy, F. F., "Seawater," Intern'l. Sci. and Tech., Dec: 52-64 (1966).

3. Moore, H. B., Marine Ecology, Wiley and Sons, New York, p. 493 (1958).

4. Thorhaug, A., "Temperature Controlled Perfusion Technique for the Study of Giant Algal Membrane Systems," Proc. 1st Eur. Biophys. Congr. (1971).

5. Thorhaug, A., "Temperature Effects on Membrane Phenomena," Ph. D. Dissertation. Univ. Miami, Coral Gables, Fla. 165 p. (1969).

6. Thorhaug, A., "Temperature Effects on Valonia Bioelectric Potential," Biochem. Biophys. Acta. 225: 151-158. (1971).



Assembly for Valonia perfusion with temperature control. A. Aluminum block. B. Mirror fitted to bottom of dish. C. Valonia cell. D. Thermometer. E. Glass stand for supporting cell. F. Stirring motor. G. Thermistor needle impaled into cell. H. Efflux pipet I. Influx pipet. I. 0.5 M KCl solution K. Temperature Jacket for influx fluid. L. Reservoir for inflow sap. M. Connecting inflow tubing from temperature control bath. N. Connecting outflow tubing to temperature controlled bath. O. Teflon adapter for syringe containing inflow fluid. P. Artificial sap. Q. Thermistor for temperature control apparatus. R. Temperature control apparatus. S. Knife blade heater. T. Temperature bath. U. Cooling coils. V. Electrode. W. KCL solution. X. Salt bridge with vycor tips. Y. Voltmeter. Z. Conductance bridge. Ω - Pump. ϕ-Absorption dish.

Dr. Anitra Thorhaug

"The Effect of Temperature and Temperature Gradients on the Living Cell Membrane"

BUDGET

November 1, 1971 - October 31, 1972

SALARIES		
Principal Investigator Dr. Anitra Thorhaug 94.2% of time	$14,325.	
Retirement @ 5.5%	788.	
Total Salaries and Retirement		$15,113.
SUPPLIES AND SERVICES		
Travel		500.
Expendable Equipment and Supplies		500.
Fica ($346) and Insurance ($100)		446.
CAPITAL EQUIPMENT		565.
TOTAL DIRECT COSTS		$17,124.
INDIRECT COSTS (55% of Salaries and Retirement)		8,312.
TOTAL COST OF PROJECT		$25,436.
UNIVERSITY OF MIAMI COST SHARING		4,888.
TOTAL FROM NASA		$20,548.

The Role of Clathrate Formation in the Organic Chemistry of Ocean Sediments

Investigator: Eugene H. Man, Ph. D.
Professor of Chemistry and Chemical Oceanography

Consultant: Jeffrey L. Bada, Ph. D.
Scripps Institution of Oceanography
University of California at San Diego

Introduction

One view held by many environmental scientists is that the oceans hold the key to Man's continuing ability to survive on his planet. This view may be based on the oceans as a source of food, water (after processing), mineral or organic resources, or alternatively, as a major receptacle for the residues of man and nature.[1] Organic materials enter the oceans as run-off from land masses, from marine organisms, from shell fragments or from detritus materials. Run-off from the land consist primarily of organic and inorganic animal residues, chlorinated hydrocarbons and other decomposition residues from pesticides, radionuclides, metals from inorganic fertilizers and petroleum derived hydrocarbons. The greatest portion of these organic materials is relatively insoluble in sea water itself and eventually settles to the ocean bottom in combination with particulate matter and inorganic sediments. Although the greatest concentration of organic material is found near shores and river basins, deep sea sediments contain significant amounts of organic residues including amino acids found in the proteins of organisms.[2]

A primary constituent of marine sediment consists of clays of the bentonite or montmorillonite family, a class of materials which have been known to form specialized complexes with organic materials known as inclusion compounds or clathrates.[3] These complexes differ from other complex compounds in that the molecules of their components are associated without ordinary chemical bonding. The firmness by which the included material (guest) is held to the surrounding cage structure (host) gave rise

to the term "clathrate," derived from the Latin clathratus, meaning enclosed or protected by cross bars of a grating.

Beginning with Palin and Powell's work in the late 1940's[4], a wide variety of materials have been investigated as the cage-forming component of clathrates. The included or guest molecules capable of forming clathrates are infinite, depending on steric and other spatial considerations. The lattice-forming components have been classified into three main categories by Barrer:[5] (a) Those cages which are crystalline and stable without change whether included molecules are present or not (e. g., faujacite or other zeolites); (b) those in which the content of the included molecules may be changed within limits, but are subject to metastability and recrystallization below certain concentrations (urea or thiourea adducts); and (c) those which show a more or less continuous adjustment as the content of the included molecules falls or increases. These latter are called "lamellar" or "intercallation" complexes, such as formed by montmorillonite, because the spaces into which the host molecules fit are located in layers in the interstices of the solid material.

Although there are no chemical bonds between the host cage material and the enclosed guest molecules in the usual sense, X-ray analysis of clathrates has indicated that weak van der Waals' forces, highly oriented dipole interactions and hydrogen bonding may play important roles in host-guest interaction.[6] Earlier work by this investigator (unpublished) indicated that clathrate formation can inhibit hydrolysis or oxidation, affect the rate and course of bimolecular reactions, enhance or inhibit enzymatic action, and, in the case of montmorillonite, affect the resonance of dye moieties to effect color change.

This project is designed to demonstrate the effects of clathrate formation between organic species in ocean sediments and the montmorillonite or other clay component in these sediments. Such effects on the chemistry of organics in ocean sediments will have importance in understanding the organic chemistry of ocean sediments, which relates to ocean productivity, the fate of pollutants and other organic residues, and should also play an important role in understanding some geochemical phenomena. An example of the latter is the dating of marine sediments by measuring the racemization of amino acids by Bada[7], in whose laboratory at Scripps Institution of Oceanography much of this work will be carried out while the Investigator is on leave of absence from his administrative duties at the University of Miami. The Investigator also plans to spend two or more months in the laboratory of Dr. E. T. Degens at Woods Hole Oceanographic Institution.

Objectives

This project is a pilot study to determine the effect of clathrate formation in ocean sediments on the organic chemistry in these sediments.

An attempt will be made to relate effects demonstrated in the laboratory to organic interactions occuring naturally in selected oceanic sediments.

Program

Initial efforts will concentrate on developing model systems in the laboratory to demonstrate the effect of clathrate formation between montmorillonite and selected organic species resembling materials found in natural marine sediments. Primary attention will be given to the reactions of amino acids and of hydrocarbons as examples of the most common organic components of sediments. Reactions to be investigated include synthesis, degradation and racemization of amino acids, synthesis and degradation of polypeptides, and synthesis and degradation of simple hydrocarbons. Rates of reaction, as well as end products derived from oxidation, hydrolysis, amination, and condensation will be compared between materials held in clathrate combination in montmorillonite and in the absence of clay, with a determination of the effects of temperature, pH, concentration and the presence or absence of interfering organic and inorganic species found in nature.

Sediments from a variety of depths and locations will be collected by coring and dredging in the waters of the Bahamas and Caribbean during a cruise on the University of Miami research vessel Gillis in late November and early December. Organic materials will be extracted and isolated from these sediments using the method of Bada[7], and will be utilized in the laboratory model systems with montmorillonite. Comparison of the chemical activity of the organic species found with that of compounds in the model systems will constitute the major effort of this project.

Personnel

Dr. Eugene H. Man is Principal Investigator, on leave from the University of Miami as Dean of Research Coordination. Work will be carried out in the laboratory of Dr. Jeffrey Bada at Scripps Institution of Oceanography, who will act as consultant. This work will be closely tied into ongoing programs dealing with the organic chemistry of marine sediments at the Rosenstiel School of Marine and Atmospheric Science at the University of Miami (Dr. Richard Bader), and at the Woods Hole Oceanographic Institution (Dr. E. T. Degens).

References

1. Olson, T. A. and Burgess, F. J., (Ed.) Pollution and Marine Ecology, Interscience Publishers, New York (1967).

2. Degens, E. T., Geochemistry of Sediments, Prentice-Hall, Englewood Cliffs, New Jersey (1965).

3. Hagan, Sister M., Clathrate Inclusion Compounds, Reinhold Publishing Corp., New York (1962).

4. Palin, D.E. and Powell, H.M., J. Chem. Soc., 1947, p. 208.

5. Barrer, R. M., Quart. Revs. (London), pp. 3, 293 (1949).

6. Wheland, G. W., Advanced Organic Chemistry, 3rd Ed., John Wiley & Sons, Inc., New York (1960), p. 155.

7. Bada, J.L. et al, Science, 13 Nov. 1970, pp. 730-732.

Dr. Eugene H. Man

"The Role of Clathrate Formation in the Organic Chemistry of Ocean Sediments"

BUDGET

November 1, 1971 - October 31, 1972

SALARIES		
Principal Investigator Dr. Eugene H. Man Part-Time	10,000.	
Retirement @ 5.5%	550.	
Total Salaries and Retirement		$10,550.
SUPPLIES AND SERVICES		
Travel		
3 Round Trips California to Miami @ $400	1,200.	
1 California, Woods Hole, Miami	500.	1,700.
Chemical Supplies		500.
Expendable Equipment		449.
Fica ($204) and Insurance ($70)		274.
TOTAL DIRECT COSTS		$13,473.
INDIRECT COSTS (68% of Salaries and Retirement)		7,174.
TOTAL COST OF PROJECT		$20,647.
UNIVERSITY OF MIAMI COST SHARING		4,480.
TOTAL FROM NASA		$16,167.

STATEMENT OF UTILIZATION OF FUNDS
SUMMARY BY EXPENDITURE CATEGORY
November 1, 1971 --- October 31, 1972

(See detailed budgets for each project included in proposal)

SALARIES (including retirement)		
Professional		$27,263.
SUPPLIES AND SERVICES		
Expendable equipment and supplies, publications, communications, etc.	5,599.	
Domestic travel	2,200.	
Employee benefits (Fica and group insurance for faculty)	806.	
Total Supplies and Services		8,605.
CAPITAL EQUIPMENT		5,800.
TOTAL DIRECT COSTS		$41,668.
INDIRECT COSTS*		17,700.
TOTAL PROJECT COSTS		$59,368.
UNIVERSITY OF MIAMI CONTRIBUTION**		9,368.
TOTAL NASA FUNDS***		$50,000.

* Indirect Costs
Main Campus 68% of Salaries and Retirement
Medical Campus 55% of Salaries and Retirement

** Represents difference between % of salaries plus retirement and 20% of total direct costs.

*** Total direct costs plus indirect costs computed at 20% of total direct costs.

STATEMENT OF UTILIZATION OF FUNDS
SUMMARY BY PROJECT
NASA NGL-10-007-010 -- Seventh Year

(Final Year)

Investigator	Reference*	Personnel	Supplies & Services	Equipment	Direct Costs	Indirect Costs	Total Costs	UM Cost Sharing	NASA Funds
Drs. Davidoff, Evoy, Joffe, & Schneiderman	8	$ 1,600.	$ 4,236.	$ 5,235.	$11,071.	$ 2,214.	$13,285.	--	$13,285.
Dr. Thorhaug	13	15,113.	1,446.	565.	17,124.	8,312.	25,436.	$ 4,888.	20,548
Dr. Man	18	10,550.	2,923.	--	13,473.	7,174.	20,647.	4,480.	16,167
Totals		$27,263.	$ 8,605.	$ 5,800.	$41,668.	$17,700.	$59,368.	$ 9,368.	$50,000

*Page number, detailed budget

CURRICULUM VITAE

NAME:

Robert A. Davidoff, M. D.
Associate Professor of Neurology and Pharmacology
School of Medicine, University of Miami

BORN:

Brooklyn, New York
October 5, 1934

DEGREES:

B. S.	1955	University College of Arts and Sciences, New York University Magna Cum Laude
M. D.	1958	New York University

PROFESSIONAL EXPERIENCE:

1958-59	Intern, NYU Medical Division, Bellevue Hospital
1959-60	Assistant Medical Resident, NYU Medical Division, Bellevue Hospital, Assistant in Medicine, NYU School of Medicine
1960-61	Assistant Neurological Resident, Mt. Sinai Hospital, New York
1961-63	Research Neurologist, U. S. Navy (Lt., M. C., USNR); assigned to U. S. Naval Medical Neuropsychiatric Research Unit, San Diego, Cal.
1963-65	Neurological Resident, Mt. Sinai Hospital, N. Y.
1965-66	Research Associate, U. S. Veterans Administration Hospital, Indianapolis, Indiana
1965-67	Instructor, Department of Psychiatry, Indiana University, School of Medicine
1966-69	Clinical Investigator, U. S. Veterans Adminiatration Hospital, Indianapolis, Indiana
1967-69	Assistant Professor, Department of Psychiatry, Indiana University School of Medicine
1968-69	Assistant Professor, Department of Neurology, Indiana University, School of Medicine
1969-	Associate Professor, Department of Neurology, University of Miami, School of Medicine

CURRICULUM VITAE

of

Robert A. Davidoff (cont.)

PROFESSIONAL EXPERIENCE: (cont.)

1970-	Associate Professor, Department of Pharmacology, University of Miami, School of Medicine
1970-	Member, Committee on Cellular and Molecular Biology

MEMBERSHIPS AND HONORS:

Phi Beta Kappa
American Academy of Neurology
American Association for the Advancement of Science
Indiana Neurological Society
American Association of University Professors
Sigma Xi

LICENSE DATA:

Diplomate, National Board of Medical Examiners, 1959
New York State Medical License, 1959
California State Medical License, 1963
Florida State Medical License, 1970

SPECIALTY BOARDS:

Diplomate, (Neurology), American Board of Psychiatry and Neurology, 1966

HOSPITAL STAFF APPOINTMENTS:

Jackson Memorial Hospital, Miami, Florida 1970
U.S. Veterans Administration Hospital, Miami, Fla. 1970

PUBLICATIONS AND PAPERS: (Five most recent)

Aprison, M.H., Shank, R.P. and Davidoff, R.A. "A Comparison of the Concentration of Glycine, a Transmitter Suspect in Different Areas of Brain and Spinal Cord in Seven Different Vertebrates." Comp. Biochem. Physiol. 28:1345-1355, 1969.

CURRICULUM VITAE

of

Robert A. Davidoff (cont.)

PUBLICATIONS AND PAPERS: (cont.)

Davidoff, R. A., Aprison, M. H. and Werman, R. "The Effects of Strychnine on the Inhibition of Interneurons by Glycine and GABA." Int. J. Neuropharmacol. 8:191-194, 1969.

Aprison, M. H., Davidoff, R. A. and Werman, R. "Glycine, Its Metabolic and Possible Transmitter Roles in Nervous Tissue," in Handbook of Neurochemistry, Vol. III, ed. A. Lajtha. Plenum Press, New York, 1970, pp. 381-397.

Davidoff, R. A. "Drug Treatment of Spasticity," Letter to Editor, Lancet, II: 1131, 1970.

Davidoff, R. A. and Ruskin, H. M. "The Effects of Microelectrophoretic Application of Thyroid Hormone to Single Cat Neurons," Neurology, 21: 432, 1971. (Abstract).

CURRICULUM VITAE

NAME:

William Harrington Evoy
Associate Professor of Biology

BORN:

Philadelphia, Pennsylvania
July 1, 1938

DEGREES:

B. A.	1960	Reed College
M. A.	1962	University of Oregon
Ph. D.	1964	University of Oregon

PROFESSIONAL EXPERIENCE:

1959-60 (summers)	Research Assistant, U. S. Fish & Wildlife Service Biological Laboratory, Woods Hole, Mass.
1960-61	Teaching Assistant, University of Oregon
1961-64	U. S. Public Health Service Trainee, University of Oregon
1964	Grass Foundation Fellow, Marine Biological Laboratory, Woods Hole, Mass. (Summer)
1964-66	Research Associate, Dept. Biological Sciences, Stanford University (With Prof. Donald Kennedy)
1966-69	Assistant Professor of Biology, University of Miami
1969-	Associate Professor of Biology, University of Miami

MEMBERSHIPS AND HONORS:

American Society of Zoologists
Society for General Physiologists
American Association for the Advancement of Science
Division of Comparative Physiology, ASZ

PUBLICATIONS AND PAPERS: (Five most recent)

Evoy, William H. and Melvin S. Cohen. "Central and Peripheral Control of Arthropod Movements. (Review Article) Advances in Comp. Physiol. and Biochem. Vol. 4, 1971.

CURRICULUM VITAE

OF

William H. Evoy (cont.)

PAPERS AND PUBLICATIONS: (cont.)

Evoy, William H. and Jones, Brooks P. "Motor Patterns of Male Euglossine Bees Evoked by Floral Fragrances," Animal Behaviour (In Press).

Evoy, William H. and Cohen, Melvin J. "Sensory and Motor Interaction in the Locomotor Reflexes of Crabs," J. Exp. Biol., Vol. 51, pp. 151-169. 1969.

Kennedy, Donald, Evoy, William H., and Fields, Howard L. "The Unit Basis of Some Crustacean Reflexes," Symp. Soc. Exp. Biol., Vol. 20, pp. 75-109, 1967.

Evoy, William H., Kennedy, Donald, and Wilson, Donald M. "Discharge Patterns of Neurones Supplying Tonic Abdominal Muscles in the Crayfish," J. Exp. Biol. Vol. 46, pp. 393-412, 1967.

CURRICULUM VITAE

NAME:

Seymour Joffe
Associate Professor of Neurology and Biology
Assistant Professor of Biochemistry
University of Miami

BORN:

New York, New York
November 15, 1928

DEGREES:

B. S.	1949	New York University
M. D.	1953	New York University, College of Medicine
Ph. D.	1967	Albert Einstein College of Medicine

PROFESSIONAL EXPERIENCE:

1954-56	Medical Officer, U. S. Navy
1956-58	Postdoctoral Fellow in Biochemistry, Western Reserve University, College of Medicine
1959-61	Assistant Instructor, Albert Einstein College of Medicine, Department of Neurology
1961-65	Instructor, Albert Einstein College of Medicine, Department of Neurology
1961-65	Assistant Visiting Neurologist, Bronx Municipal Hospital Center
1965 - Present	Associate Professor of Neurology, Assistant Professor of Biochemistry, University of Miami, School of Medicine
1969 - Present	Associate Professor of Biology, University of Miami, College of Arts & Sciences

CURRICULUM VITAE

Seymour Joffe (cont.)

PUBLICATIONS AND PAPERS: (five most recent)

Identification of an Organ Specific Lipid Hapten in Brain. Nature, 197, 60, 1963 (with Rapport and Graf)

A Nuclear Magnetic Resonance Study of Hapten-Antibody Interaction. J. Mol. Pharm., 3, 399, 1967.

Immunochemical and Physiochemical Studies of Hapten-Antibody Interaction. Doctoral thesis, Albert Einstein College of Medicine, 1967.

Analytic and Biosynthetic Interrelationships Among the Ethanolamine Phosphatides in Myelinating Rat Brain. Federation Proceedings, 27, 817, 1968.

Interrelationships Among the Ethanolamine Phosphatides in Myelinating Rat Brain. J. Neurochem., 16, 715, 1969.

CURRICULUM VITAE

NAME:

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University of Miami

BORN:

Scranton, Pennsylvania
December 14, 1923

DEGREES:

A.B.	1948	Oberlin College
Ph.D.	1952	Duke University

PROFESSIONAL EXPERIENCE:

1952-58	Research Chemist, Central Research Department, E.I. duPont de Nemours & Co., Wilmington, Delaware
1958-60	Research Chemist, Textile Fibers Department, E.I. duPont de Nemours & Co., Wilmington, Delaware
1960-61	Supervisor, Technical Section, Textile Fibers Nylon Division, E.I. duPont de Nemours & Co., Chattanooga, Tennessee
1961-62	Senior Supervisor, same as above
1962-66	Coordinator of Research, University of Miami
1966-Present	Dean of Research Coordination, University of Miami
1968-Present	Professor of Chemistry, University of Miami
1971-	Professor of Chemical Oceanography, University of Miami

CURRICULUM VITAE
Eugene H. Man (cont.)

MEMBERSHIPS AND HONORS:

Sigma Xi
American Chemical Society
AAAS
Phi Lambda Upsilon
Harry N. Holmes Award in Chemistry (Oberlin)
Office of Naval Research Fellow (Duke 1948-49)
E. I. duPont de Nemours Fellow (Duke 1950-52)
Phi Beta Kappa (Duke, 1952)

PUBLICATIONS AND PAPERS:

Total of eight publications (1950-58)

PATENTS:

U.S. Patent 2,820,807, Jan. 21, 1958 - "Trifluoromethyl thiol esters"

U.S. Patent 2,904,476, Sept. 15, 1959 - "Electrolytic Preparation of Sulfur Hexafluoride"

U.S. Patent 3,328,892, July 4, 1967 - "Process for Deswelling a Water-Swollen, Highly Hydrophylic Gel Fiber"

CURRICULUM VITAE

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BORN:

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DEGREES:

A. B.	1960	Brooklyn College
Ph. D.	1964	Indiana University

PROFESSIONAL EXPERIENCE:

1960-61	Pre-doctoral Teaching Assistant, Indiana University
1961-64	Pre-doctoral Research Assistant, Indiana University
1963-64	Pre-doctoral Teaching Associate, Indiana University
1964-65	Post-doctoral Assistant to Director of Physiological Institute, Prof. Dr. Med. Marcel Monnier Basle, Switzerland
1965-68	Assistant Professor of Psychology, University of Miami
1968-	Associate Professor of Psychology, University of Miami

MEMBERSHIPS AND HONORS:

American Psychological Association
Southeastern Psychological Association
Psi Chi
Sigma Xi
AAAS
Psychonomic Society

PUBLICATIONS AND PAPERS: (Five most recent)

Schneiderman, N., Dauth, G. W. and VanDercar, D. H. "Electrocardiogram," In: R. F. Thompson and M. Patterson, Recording of Bioelectric Activity, Academic Press, New York, In Press.

CURRICULUM VITAE

of

Neil Schneiderman (cont.)

PUBLICATIONS AND PAPERS (cont.):

Schneiderman, N., Pearl, L., Wilson, W., Metcalf, F., Moore, J., and Swadlow, H.A. "Stimulus Control in Rabbits as a Function of Different Intensities of Intracranial Stimulation," J. Comp. Physiol. Psychol., Vol. 76, 1971, pp. 175-186.

Powell, D.A., Schneiderman, N., Elster, A.J., and Jacobson, A. "Differential Classical Conditioning in Rabbits (Oryctolagus cuniculus) to Tones and Changes in Illumination," J. Comp. Physiol. Psychol., 1971, Vol. 76, pp. 267-274.

Powell, D.A., Francis, J. and Schneiderman, N. "The Effects of Castration, Neonatal Injections of Testosterone and Previous Experience with Fighting on Shock-Elicited Behavior," Communications in Behavioral Biology, 1971, In Press.

Swadlow, H.A., Hosking, K. and Schneiderman, N. "Differential Heart-Rate Conditioning and Lever Lift Suppression in Restrained Rabbits," Physiology and Behavior, 1971, Vol. 7, pp. 257-260.

CURRICULUM VITAE

NAME:

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BORN:

Chicago, Illinois
June 1, 1940

DEGREES:

B. S.	1963	University of Miami
M. S.	1965	University of Miami
Ph. D.	1969	University of Miami

PROFESSIONAL EXPERIENCE:

1966	Biophysics Fellowship, Stanford University
1967	NASA Fellow, University of Miami
1967	Research Assistant, University of Miami (NSF Inst. Grant)
1967	UNESCO Post-doctoral Fellow, University of Homberg
1968	Koczy Senior Fellow in Oceanography, University of Miami
1969	Consultant, Medical School, Duke University
1969	Hoover Commission on Thermal Pollution
1969-70	ESSA Post-doctoral in Chemical Oceanography
1969	Consultant, College of Physicians and Surgeons, Department of Biochemistry, Columbia University
1970	Research Scientist, University of Miami
1971	Post-doctoral, Weizmann Institute, Rehovot, Israel
1971	Guest Lecturer, Marine Biological Laboratory, Elat, Israel
1971	Guest Lecturer, Duke University
1971-	Research Scientist, Department of Microbiology, University of Miami

MEMBERSHIPS AND HONORS:

International Union for Pure and Applied Biophysics
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CURRICULUM VITAE

of

Anitra Thorhaug (cont.)

MEMBERSHIPS AND HONORS: (cont.)

AIBS
American Society of Botany
American Society of Phycologists
American Society of Protozoologists
British Society of Phycologists

PUBLICATIONS AND PAPERS: (Five most recent)

Thorhaug, A. (with Aharon Katchalsky) "The Role of Thermoosmosis on Marine Macroalgae." Proc. VII Seaweed Symposium. (In Press.) 1971.

Thorhaug, A. (with Aharon Katchalsky) "Marine Biophysics: Problems and Perspectives," Proc. First European Biophys. Congress (In Press.) 1971.

Thorhaug, A. (with T. Devany and B. Murphy) "Refining Shrimp Culture Methods: the Effect of Temperature," Bull. Gulf Carib. Fish. (In Press.) 1971.

Thorhaug, A. (with R. Stearnes) "A Field Study of Marine Grasses in a Tropical Marine Estuary Before and After Heated Effluents." American Journal of Botany. (In Press). 1971.

Thorhaug, A. (with F. F. Koczy) "Interfaces in the Ocean," Contract with Elsevier Press for Series on Oceanography.